WORKSHOP
STOCHASTIC AND FINANCE
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HERAKLION, CRETE

TALKS AND ABSTRACTS

Day 1: Tuesday, July 18, 2017

Optimal Strategies Under Omega Ratio

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Abstract. We study optimal investment strategies under the objective of maximizing the Omega ratio, proposed by Keating and Shadwick (2002) as an alternative to the Sharpe ratio for performance assessment of investment strategies. We show that in a standard set-up of the financial market the problem is ill-posed, i.e., maximizing the Omega ratio leads to excessive risk taking. By imposing additional restrictions we show that the Omega ratio maximizing strategy is still very risky and may coincide with the choice made by risk neutral investors. We conclude that caution is needed when using the Omega ratio for making asset allocation decisions.

Joint work with Carole Bernard and Ye Jiang.

Cost efficient strategies under model ambiguity

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Abstract. An investment strategy is cost-efficient if it allows to achieve a given probability distribution with the minimum possible budget. The solution to the standard cost efficiency problem depends crucially on the fact that a single real-world measure P is available to the investor. In most applications of interest however, a historical measure is neither given nor can it be estimated with accuracy from available data. Thus investors are facing uncertainty about the measure P. To incorporate this kind of uncertainty in the cost efficiency approach we assume that, instead of a single measure, a class of plausible prior models is available.

Based on a paper of Thibaut Lux and Steven Vanduffel.

Pricing and hedging in (in)complete financial markets (an overview)

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Abstract. The main goal of the talk is to overview the literature on the basic models and fundamental results of pricing contingent claims in financial markets. We will start

with the standard models in discrete and continuous time and give the first and the second fundamental theorems of asset pricing that connect the notion of markets completeness and the probability measures under which the market is a (local) martingale. Then, the main idea of pricing through utility functions is going to be described and a discussion on the related equilibrium pricing models will conclude the talk.

Windings and Asian options, Part I: Windings and Exponential Functionals

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Abstract. During the last few decades, two-dimensional (planar) processes have attracted the interest of many researchers. This happens both because of the richness of the behavior of their trajectories from a theoretical point of view and because their study turns out to be very fruitful in terms of applications (e.g. in Finance, but also in other fields). A reason for that is because planar processes are strongly related to exponential functionals e.g. of Brownian motion, which are very common quantities in Mathematical Finance. For instance, when pricing an Asian call option, the payout is given by

$$E\left[\left(\frac{1}{t}\int_0^t ds\ \exp(B_s+\nu s)-K\right)^+\right],$$

where $(B_u, u\geq 0)$ is a real Brownian motion starting from 0, $\nu\in\mathbb{R}$ and $K\in\mathbb{R}_+$.

In order to compute this quantity, one needs to characterize the distribution of the exponential functional $\int_0^t ds\ \exp(B_s+\nu s)$. We will be mainly interested in this exponential functional in terms of planar Brownian motion, that is:

$$\int_0^{T_c^\gamma} ds\ \exp(2B_s),$$

where $T_c^\gamma=\inf\{u\geq 0:\gamma_u=c\}$, $c>0$, and $(\gamma_u, u\geq 0)$ another real Brownian motion starting from 0, independent from B.

The first part of the talk focuses on the fine study of trajectories of planar processes, and in particular on the the way these processes move around the origin, widely known as windings. We will survey several results concerning windings of two-dimensional processes and the distribution of the (random) exit times from a cone. The latter is related to exponential functionals of planar processes. The processes in discussion in both talks will include planar Brownian motion (BM), complex-valued Ornstein-Uhlenbeck (OU) processes and planar stable processes. We will first characterize the distribution of these exponential functionals via Gauss-Laplace transforms and then we will be interested in the asymptotic study of the processes, i.e. for the large and for the small time scale including Spitzer's asymptotic Theorem for each case.

For obtaining the above mentioned results, our starting point will be the skew-product representation. We will also introduce Bougerol's celebrated identity in law which is very useful for the study of windings of planar BM and of complex-valued OU processes. However, this approach cannot be applied to the case of planar stable processes. For the latter, we will use firstly new methods invoking the continuity of the composition function and secondly new techniques from the theory of self-similar Markov processes together with the so-called Riesz–Bogdan–Żak transform which gives the law of the stable process when passed through the spatial Kelvin transform and an additional time change.

Day 2: Wednesday, July 19, 2017

Two and three fund separation theorem under general assumptions

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Abstract. The two-fund separation theorem is a central result in portfolio theory. It is consistent with expected utility maximization under the assumption that returns are multivariate elliptically distributed. Unfortunately, real world returns exhibit skewness and cannot be accurately modeled by elliptical distributions. By contrast, the multivariate generalized hyperbolic distribution is known to provide an excellent fit to returns. In this context, we provide a three-fund theorem that is valid for any investor who maximizes an objective function that reflects risk aversion. As a special case, we recover the traditional two-fund separation theorem.

Joint work with Steven Vanduffel.

Rearrangement Algorithm and Maximum Entropy

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Abstract. We study properties of the Block Rearrangement Algorithm (BRA) in the context of inferring dependence among variables given their marginal distributions and the distribution of their sum. We show that when all distributions are Gaussian the BRA yields solutions that are close to each other" and exhibit almost maximum entropy, i.e., the inferred dependence is Gaussian with a correlation matrix that has maximum possible determinant. We provide evidence that, when the distributions are no longer Gaussian, the property of maximum determinant continues to hold. The consequences of these findings are that the BRA can be used as a stable algorithm for inferring a dependence that is economically meaningful.

Joint work with Carole Bernard and Oleg Bondarenko.

Windings and Asian options, Part II: Asian Options

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Abstract. In the second part we will turn our interest to applications in the framework of Financial Mathematics, and in particular in the pricing of Asian options.

After introducing Asian options in more details, we will first discuss the pricing of this type of options by using an independent exponentially distributed random time. This study involves windings of Brownian motion, Bessel processes and Girsanov's celebrated Theorem that we shall also recall. Then, we will focus on the pricing of Asian options by using a slightly different approach based on the first part of the talk invoking windings and Williams' "pinching method".

Finally, we will make a point on the relation between windings of Lévy Processes and Asian type options driven by jump processes. The talk will finish by proposing some open problems and perspectives for further research both from a theoretical and from an applied (mainly in Financial Mathematics) point of view.

The pricing of contingent claims and optimal positions in asymptotically complete markets

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Abstract. We study utility indifference prices and optimal purchasing quantities for a contingent claim, in an incomplete semi-martingale market, in the presence of vanishing hedging errors and/or risk aversion. Assuming that the average indifference price converges to a well defined limit, we prove that optimally taken positions become large in absolute value at a specific rate. We draw motivation from and make connections to Large Deviations theory, and in particular, the celebrated Grtner-Ellis theorem. We analyze a series of well studied examples where this limiting behavior occurs, such as fixed markets with vanishing risk aversion, the basis risk model with high correlation and the Black-Scholes-Merton model with either vanishing default probabilities or vanishing transaction costs. Lastly, we show that the large claim regime could naturally arise in partial equilibrium models.

This is a joint work with Scott Robertson (BU) and Konstantinos Spiliopoulos (BU)

A new generation of explicit algorithms for SDEs with superlinear coefficients and their applications in Finance

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